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DETERMINATION OF FE, ZN, MN, CU, CD AND PB CONCENTRATIONS IN *SCATOPHAGUS ARGUS* (LINNAEUS, 1766) FROM THE KORANGI FISH HARBOUR, KARACHI, PAKISTAN

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ABSTRACT: Fe, Zn, Mn, Cu, Cd and Pb concentrations were measured by atomic absorption spectroscopy in *Scatophagus argus* collected during January through December 2013. Muscle and liver tissues of the fish samples were analyzed to examine the differences in concentration among the above metals in different seasons of the year. Significant differences were found between the tissues, with all metals being consistently higher in liver than those in edible tissues. There appeared to be a general trend of increasing concentration in post-monsoon for Fe, Zn, Cu and Cd and in pre-monsoon for Mn and Pb. However, statistically significant differences were not found between seasons. The results may be concluded that the heavy metal amounts in spotted scat of the Korangi fish harbor do not show any threat to people health.

KEYWORDS: Heavy metals, *Scatophagus argus*, Korangi fish harbor, Karachi, Pakistan.

INTRODUCTION

Fish are eaten in a large number of countries inasmuch as it has supreme protein provides, imperative amino acids, vitamin and mineral ingredient. In developing countries like Pakistan, fish have an important place in human consumption because they are relatively cheaper and high protein content. However, fish are exposed to chemicals in contaminated coastal waters. One of the major toxic contaminants is heavy metals. Heavy metals off the anthropogenic sources are incessantly let out into marine coastal ecosystems; they are substantial well-being risks on account of their toxicity, long-dated durability, bio-accumulation, and bio-magnifications in the food chain. Heavy metal accumulation levels in fish are very important. Marine coastal ecosystems are excess sensitive to heavy metals specifically, these substances become high amounts in fish, and thus they can be used for marine pollution studies as bio-indicators.

Spotted scat, *Scatophagus argus* (Linnaeus, 1766) is normally lived in estuaries, ports, mangrove puddles, and the following reaches of rivers, especially those with excessive mineral amounts. Tiny juveniles are found in the surface layer (Kuiter and Debelius, 2001).These are used in medicine in China (Tang, 1987) and found alive fish bazaars in Hong Kong (Lee and Sadovy, 1998) and consumed as fresh (Rainboth, 1996). They feed on worms, crustaceans, insects and plant matter (Allen *et al.*, 2002; Kuiter and

Tonozuka, 2001; Mills and Vevers, 1989).This type of feeding behavior would be providing the main pathway for the entrance of metals. It is well studied that marine organisms including fish species concentrate certain transition elements such as Fe, Zn, Mn and Cu.

The aim of this current study is to establish mean concentration values for certain of these essential metals namely Fe, Zn, Mn and Cu and non-essential metals such as Cd and Pb in muscle and liver tissues of *S. argus* from Korangi fish harbor of Karachi, Pakistan with regard to seasons.

MATERIALS & METHODS

A total of twenty four (24) *S. argus* were collected in Korangi fish harbor during January to December 2013 in different seasons as pre-monsoon (January to April), monsoon (May, August, September) and post-monsoon (October to December) season. Fish sampling in the months of June, July was not taken because of the rough sea and restriction on movement of boats. Eight (08) fish samples were taken in each season were placed immediately in poly-ethylene bags, then put into isolated container of thermos-flask with icebox and, after then, brought to the laboratory at the same day in each study period. The total length (cm) and the body wet weight (g) of each specimen were measured (Fig. 1).

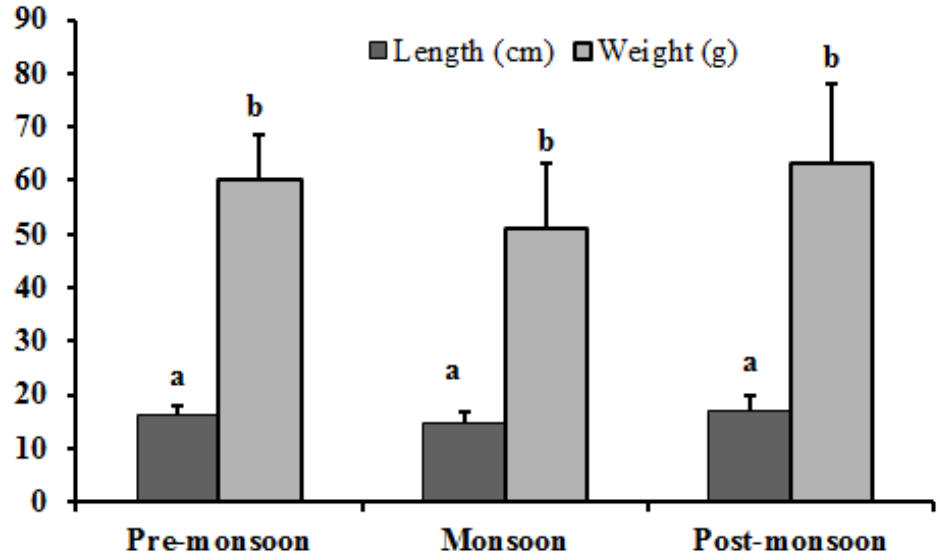

Fig. 1. Mean length and weight of *S. argus* fish collected from Korangi fish harbor in pre-monsoon, monsoon and post-monsoon seasons during January 2013 to December 2013.

Sample Preparation:

The muscle and liver tissues of the fish were prepared for analysis according to the method described by Bernhard (1976). Fishes were dissected using steel scissors and scalpels to collect remove approximately 5g dorsal muscles and entire liver, were dissected, which were washed with deionized water and then weighed. Next, The samples were then placed in a vented drying oven at 80^{o}C and allowed to dry to constant weight. After reaching a constant weight each portion was weighed on an analytical balance for a dry weight measurement. The samples were then placed in a muffle furnace and the temperature was gradually increased to 600^{o}C over a period of two hours to avoid a loss of material due to sudden combustion. The samples remained in the muffle furnace for 72 hours by which time they had been reduced to a grey to white ash. Each ash sample was weighed again to establish an ash to dry weight ratio. The weighted dry ashes were placed in 50 ml milliliter volumetric flasks and dissolved in 10 ml of (cons. HNO_3). As a means of comparison, three working standards were prepared from 1000 ppm stock solution. A calibration curve was established using standard solutions prior to every analysis. The samples were analyzed for heavy metals using the equipment AA (Analyst 700, USA) with programme win lab 32 software. The results of the research were performed using statistical methods. (ANOVA) (Zar, 1984).

RESULTS & DISCUSSION

The seasonal differences of Fe, Zn, Mn, Cu, Cd and Pb in the spotted scat, *S. argus* collected from Korangi fish harbor were studied. There are no significant differences in the weights and lengths of the fish as a result of during sampling seasons (see Fig. 1). The average heavy metal levels (Fe, Zn, Mn, Cu, Cd and Pb) detected in the edible muscle and liver tissues of *S. argus* are given shown in Fig. 2-7. In the current present investigation, Fe was the maximum in all tissues of the spotted scats followed by Zn, Cu and Mn. Akin outcomes were found by numerous researchers (Ahmed *et al.*, 2010, 2012; Bat *et al.*, 2009, 2012 and 2013). Since Fe, Zn, Cu and Mn are essential trace elements especially with regard to many enzymatic reactions, it is possible that the uptake of these trace elements is associated with metabolic activity. They are the prominent constituents of the human body, but if they are available in quantities exceeding given limits, they become toxic to most forms of organisms (Underwood, 1977*).*

There are no legal thresholds for obligatory elements in European Commission countries (Commission Regulation, 2006). However, maximum tolerance levels of Zn and Cu were recommended by the Ministry of Agriculture, Forestry and Fisheries, UK (MAFF, 1995).

The mean amount of Zn and Cu in comestible tissue of fish was rather down the maximum given standards (50 and 20 mg/kg wet wt. respectively) for human food by comparing with the Food Safety of Fish Product (MAFF,1995).

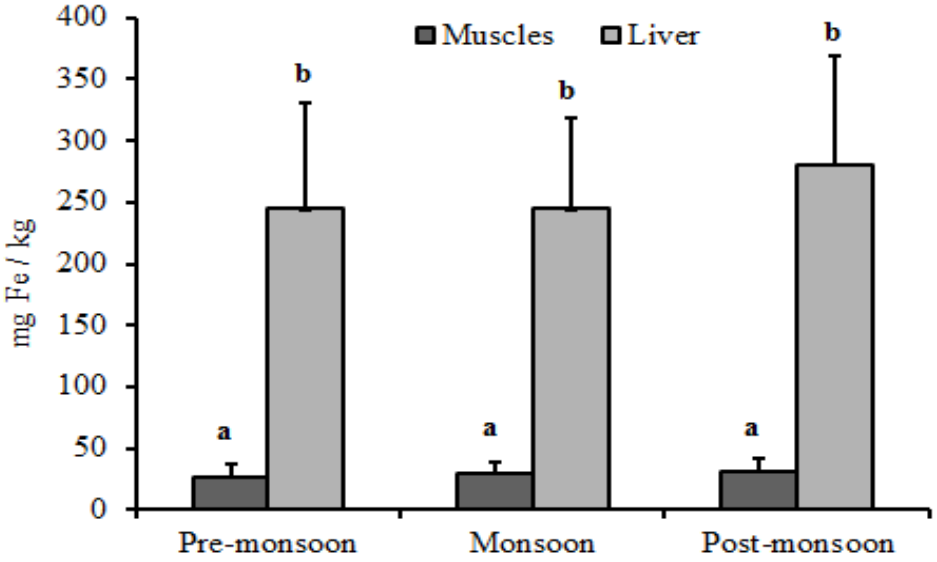

Fig. 2. Fe concentrations in muscle and liver tissues of *S. argus* collected from Korangi fish harbor during pre-monsoon, monsoon and post-monsoon seasons *during* January to December 2013.Values with different letters (a, b) represent significant differences ($p<0.05$) between the mean concentrations of heavy metal in each of the tissues.

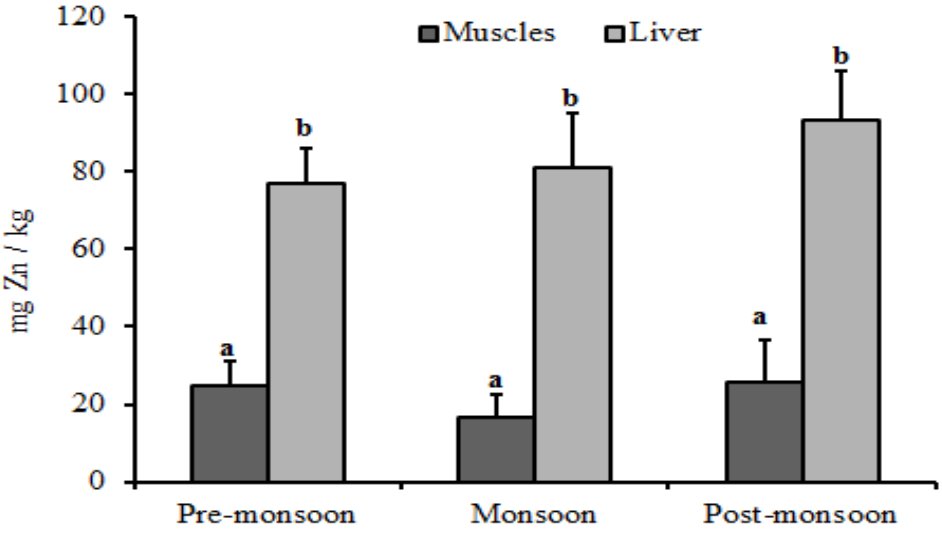

Fig. 3. Zn concentrations in muscle and liver tissues of *S. argus* collected from Korangi fish harbor during pre-monsoon, monsoon and post-monsoon seasons during January to December 2013.Values with different letters (a, b) represent significant differences ($p<0.05$) between the mean concentrations of heavy metal in each of the tissues.

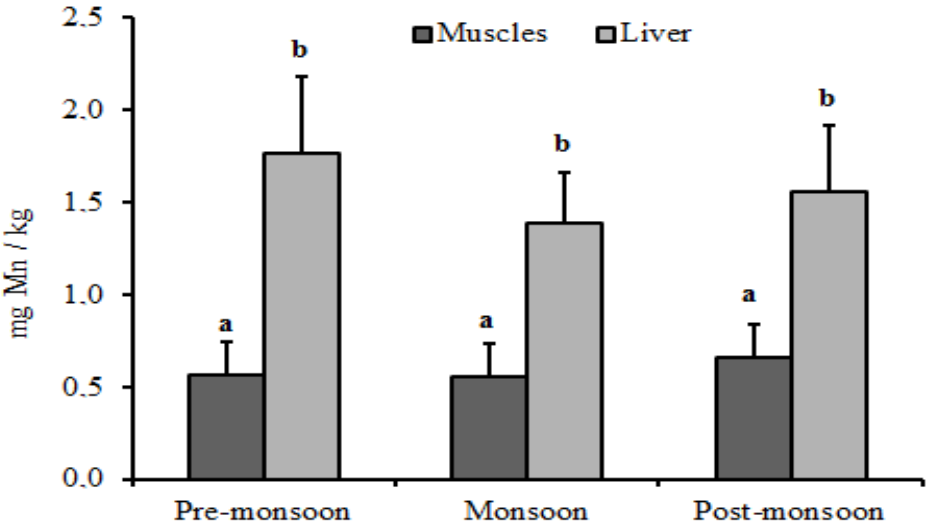

Fig. 4. Mn concentrations in muscle and liver tissues of *S. argus* collected from Korangi fish harbor during pre-monsoon, monsoon and post-monsoon seasons during January to December 2013.Values with different letters (a, b) represent significant differences ($p<0.05$) between the mean concentrations of heavy metal in each of the tissues.

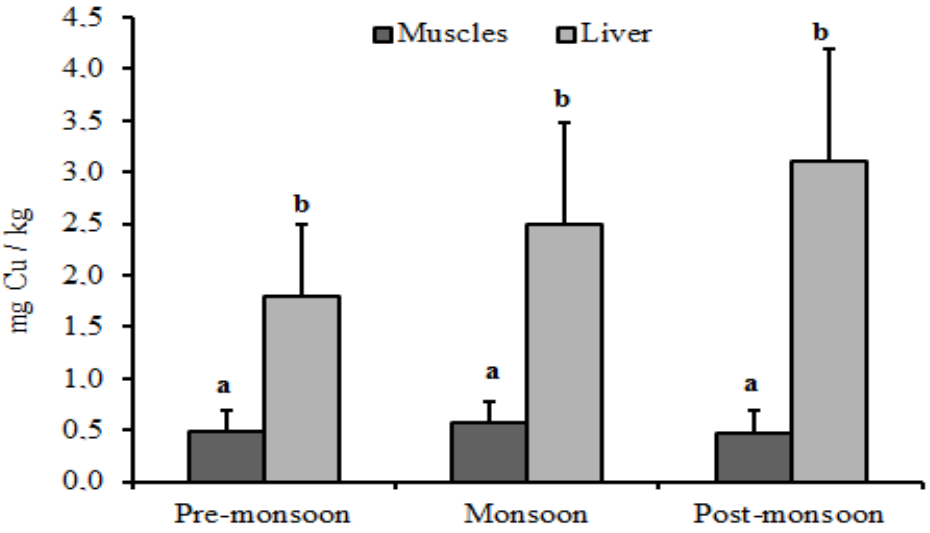

Fig. 5. Cu concentrations in muscle and liver tissues of *S. argus* collected from Korangi fish harbor during pre-monsoon, monsoon and post-monsoon seasons during January *to* December 2013.Values with different letters (a, b) represent significant differences ($p<0.05$) between the mean concentrations of heavy metal in each of the tissues.

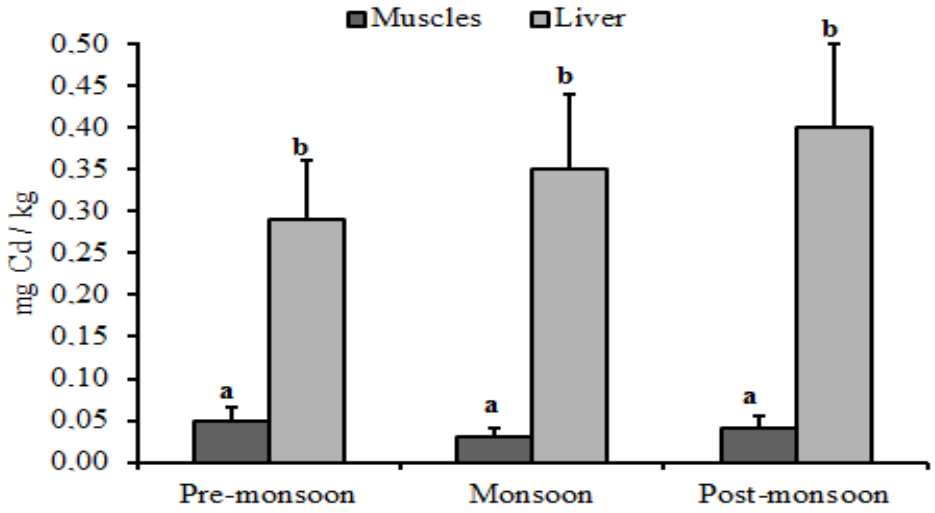

Fig. 6. Cd concentrations in muscle and liver tissues of *S. argus* collected from Korangi fish harbor during pre-monsoon, monsoon and post-monsoon seasons during January to December 2013.Values with different letters (a, b) represent significant differences ($p<0.05$) between the mean concentrations of heavy metal in each of the tissues.

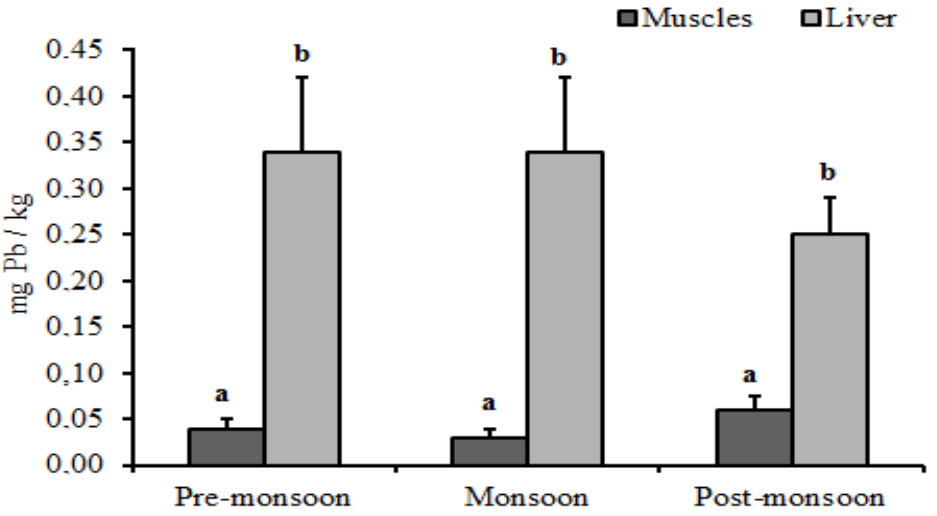

Fig. 7. Pb concentrations in muscle and liver tissues of *S. argus* collected from Korangi fish harbor during pre-monsoon, monsoon and post-monsoon seasons during January to December 2013.Values with different letters (a, b) represent significant differences ($p<0.05$) between the mean concentrations of heavy metal in each of the tissues.

Non-essential metals namely Cd and Pb have been proved to be toxic to aquatic organisms including fish as well as human via food chain. The maximum non-essential Cd and Pb amounts in all edible tissues were notably higher than the allowable levels of 0.05 and 0.30 mg/kg wet wt. given by EC (Commission Regulation, 2006). However, the results of present study were given as dry wt. When these results were converted to wet wt., the results of non-essential metals of this study are rather below the recommended levels. In conclusion, the heavy metal concentrations in *S. argus* of the Korangi fish harbor do not have any danger to human health or human consumption.

The statistical results indicate that there is a considerable greater accumulation of the metals in the liver tissues than those in the edible tissues ($P<0.05$) and that there was no any statistically significant difference among the metal levels within seasons.

There appeared to be a general trend of increasing concentration in post-monsoon for Fe ($F=0.118$; $p>0.05$), Zn ($F=0.409$; $p>0.05$), Cu ($F=2.071$; $p>0.05$)and Cd ($F=1.496$; $p>0.05$) and in pre-monsoon for Mn ($F=0.409$; $p>0.05$) and Pb ($F=0.228$; $p>0.05$). It is possible that the slightly increased concentration in post-monsoon and pre-monsoon may be responding to increased requirements owing to change in metabolic rate brought about by increased growth and reproductive activity. However, it is recommended that the liver of fish should be completely removed and very well washed before consumption.

REFERENCES

Ahmed, Q., Q.M. Ali, L. Bat, W.M. Zaheen and A.B. Baloch. 2010. Determination of Fe, Zn, Pb and Cd in the Lesser Tigertooth Croaker (Otolithes cuveri Trewavas, 1974) (SCIAENIDAE) collected from Karachi Fish Harbor. *Pak. J. Mar. Sci.* 19(1&2): 7-12.

Ahmed, Q., L. Bat and Q.M. Ali. 2012. Heavy metal levels in Thunnus albacares (Bonnaterre, 1788) from Karachi fish harbour, Pakistan. *Pak. J. Mar. Sci.* 21(1&2): 13-21.

Allen, G.R., S.H. Midgley and M. Allen. 2002. Field guide to the freshwater fishes of Australia. Western Australian Museum, Perth, Western Australia. 394 p.

Bat, L., O. Gökkurt, M. Sezgin, F. Üstün and F. Sahin. 2009. Evaluation of the Black Sea land based sources of pollution the coastal region of Turkey. *The Open Mar. Biol. J.* 3: 112-124. doi: 10.2174/1874450800903010112.

Bat, L., M. Sezgin, F. Üstün and F. Sahin. 2012. Heavy metal concentrations in ten species of fishes caught in Sinop coastal waters of the Black Sea, Turkey. *Turk. J. Fisher. Aqua. Sci.* 12: 371-376. doi: 10.4194/1303-2712-v12_2_24.

Bat, L., M. Sezgin, O.G. Baki, F. Üstün and F. Sahin. 2013. Determination of heavy metals in some commercial fish from the Black Sea coast of Turkey. *Walailak J. Sci & Tech.* 10(6): 581-589.

Bernhard, M. 1976. Manual of Methods in the Aquatic Environment Research. FAO Fisheries Technical Paper FIRI/T no. 158, Food and Agriculture Organisation, Rome.

Commission Regulation (EC). 2006. Setting maximum levels for certain contaminants in food stuffs. Commission Regulation, No. 1881/2006: *Official J. Euro. Uni.* 364, 5-24.

Kuiter, R.H. and H. Debelius. 2001. Surgeonfishes, Rabbitfishes and their Relatives. TMC Publishing, Chorleywood, UK. 208 pp.

Kuiter, R.H. and T. Tonozuka. 2001. Pictorial guide to Indonesian reef fishes. Part 3. Jawfishes - Sunfishes, Opistognathidae - Molidae. *Zoonetics*, Australia. p. 623-893.

Lee, C. and Y. Sadovy. 1998. A taste for live fish: Hong Kong's live reef fish market. *Naga ICLARM* Q. 21(2): 38-42.

Linnaeus, C. 1766. Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis. Tomus I. Editio duodecima, reformata. Holmiae. (Laurentii Salvii). 1-532.

MAFF. 1995. Monitoring and surveillance of non-radioactive contaminantsin the aquatic environment and activities regulating the disposal of wastes at sea, Aquatic Environment Monitoring Report 44, Directorate of Fisheries Research, Lowestoft, UK.

Mills, D. and G. Vevers. 1989. The Tetra encyclopedia of freshwater tropical aquarium fishes. Tetra Press, New Jersey. 208 p.

Rainboth, W.J. 1996. Fishes of the Cambodian Mekong. FAO species identification field guide for fishery purposes. FAO, Rome. 265 p.

Tang, W.C. 1987. Chinese medicinal materials from the sea. Abstracts of Chinese Medicine. 1(4): 571-600.

Underwood, E.J. 1977. Trace elements in human and animal nutrition, 4th edition, Academic Press, New York.

Zar, J.H. 1984. Biostatistical analysis (2^{nd} edition). Prentice Hall, Int. New Jersey.